

Observing Clouds and Contrails for GLOBE and NASA

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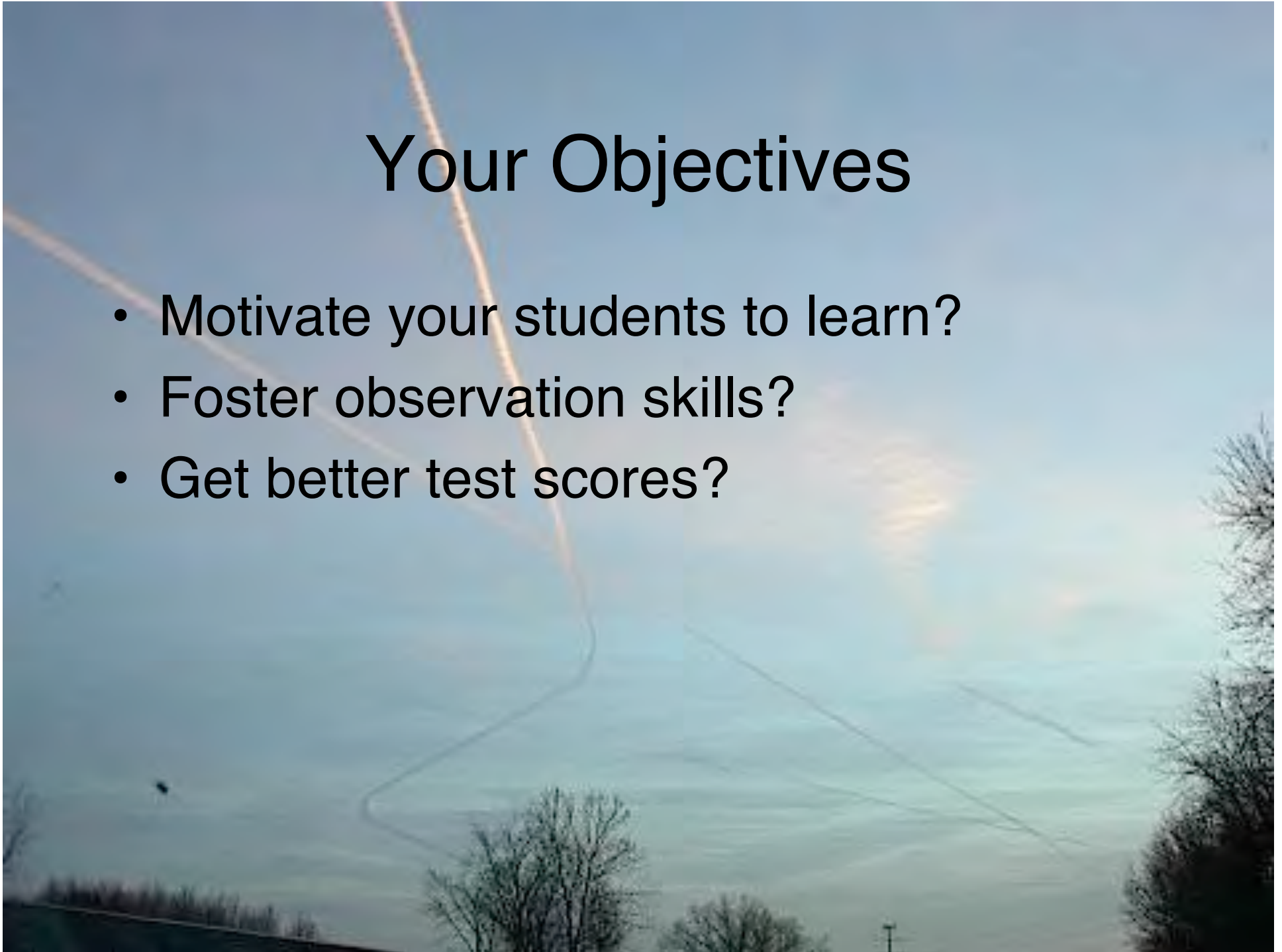


Our Objectives

- Obtain contrail and other cloud information from the largest possible network of ground observers
- Use to:
 - Validate satellite retrieval algorithms
 - Improve contrail prediction methods

Your Objectives

- Motivate your students to learn?
- Foster observation skills?
- Get better test scores?



Outline

- What are contrails?
- Why is NASA involved?
- Why and how are students important to this study?

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What are Contrails?

- Contrails are **CLOUDS** that form in the wake of aircraft.
- Contrail is a shortened name for condensation trails.
- Also known as vapor trails, jet trails, “chemtrails”



Contrails have been around for a long time!



- They were first described in the scientific literature in 1919.
- During WWII, contrails sometimes littered the skies during aerial combat.

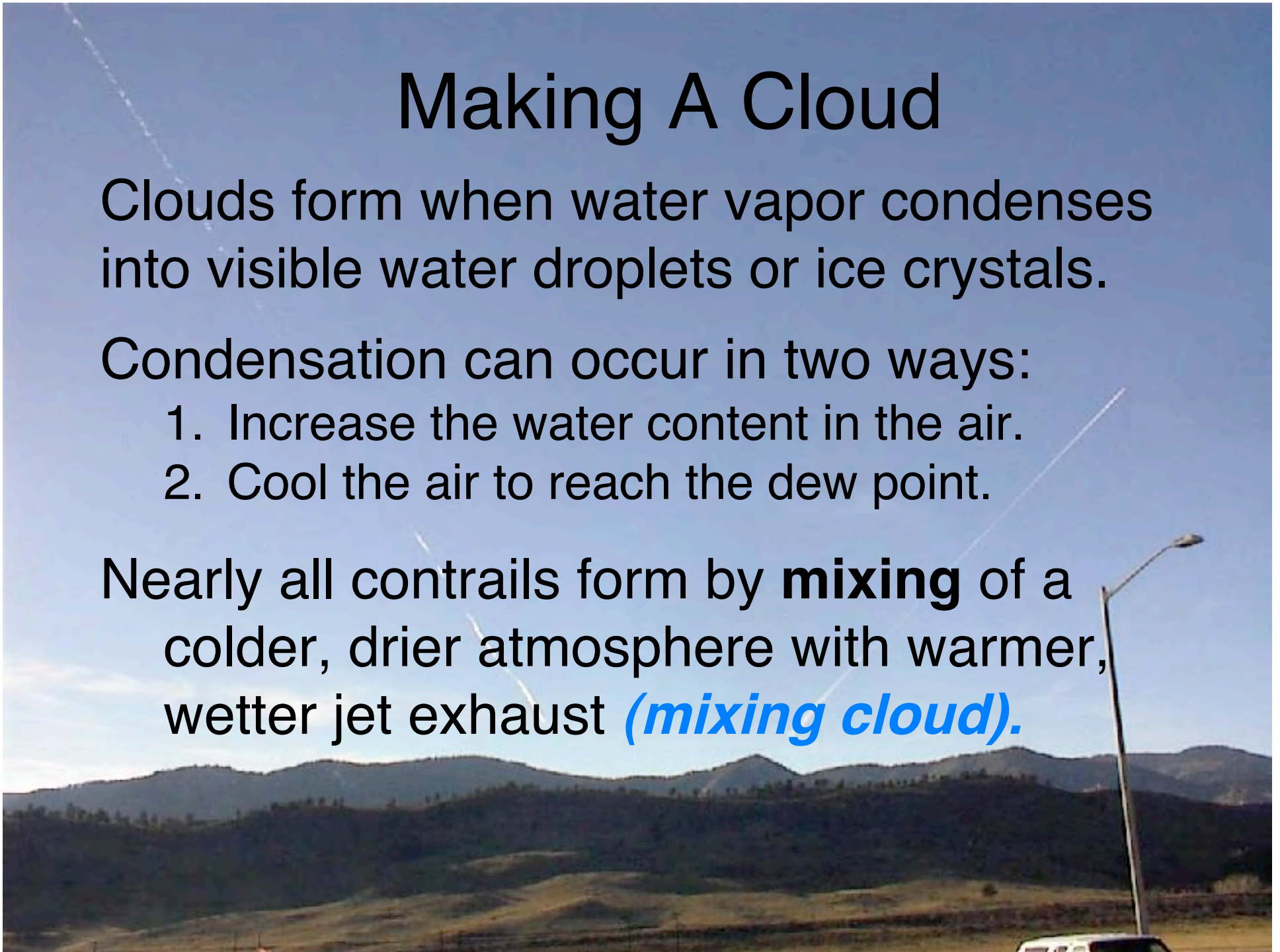
Making A Cloud

Clouds form when water vapor condenses into visible water droplets or ice crystals.

Condensation can occur in two ways:

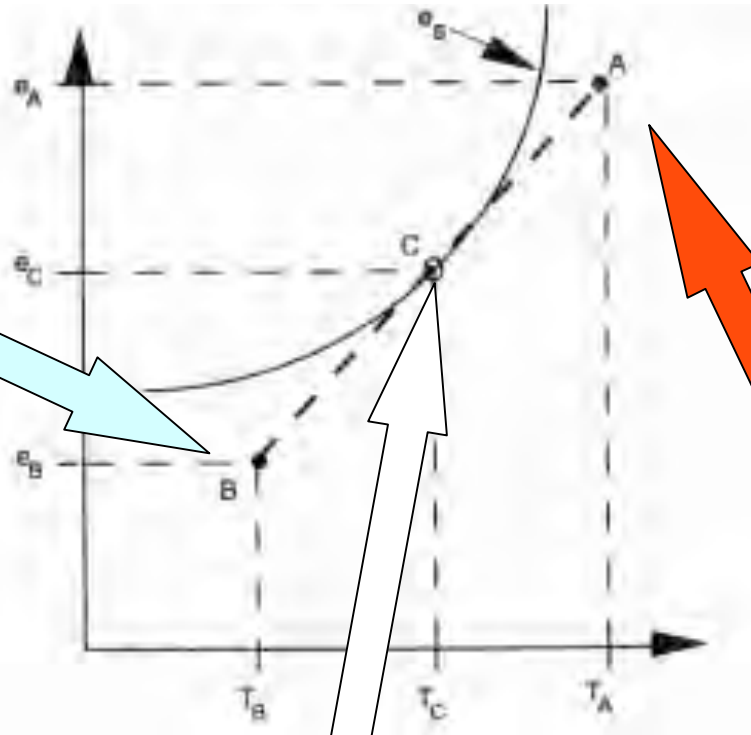
1. Increase the water content in the air.
2. Cool the air to reach the dew point.

Nearly all contrails form by **mixing** of a colder, drier atmosphere with warmer, wetter jet exhaust (*mixing cloud*).



What is a Mixing Cloud?

B. Cold, dry air in upper atmosphere



A. Hot, moist air from plane exhaust

C. If you cross the line ...
contrail!

The cloud that forms
on your breath during
a cold day is a mixing
cloud

Do Contrails Affect Cloud Cover?



Outline

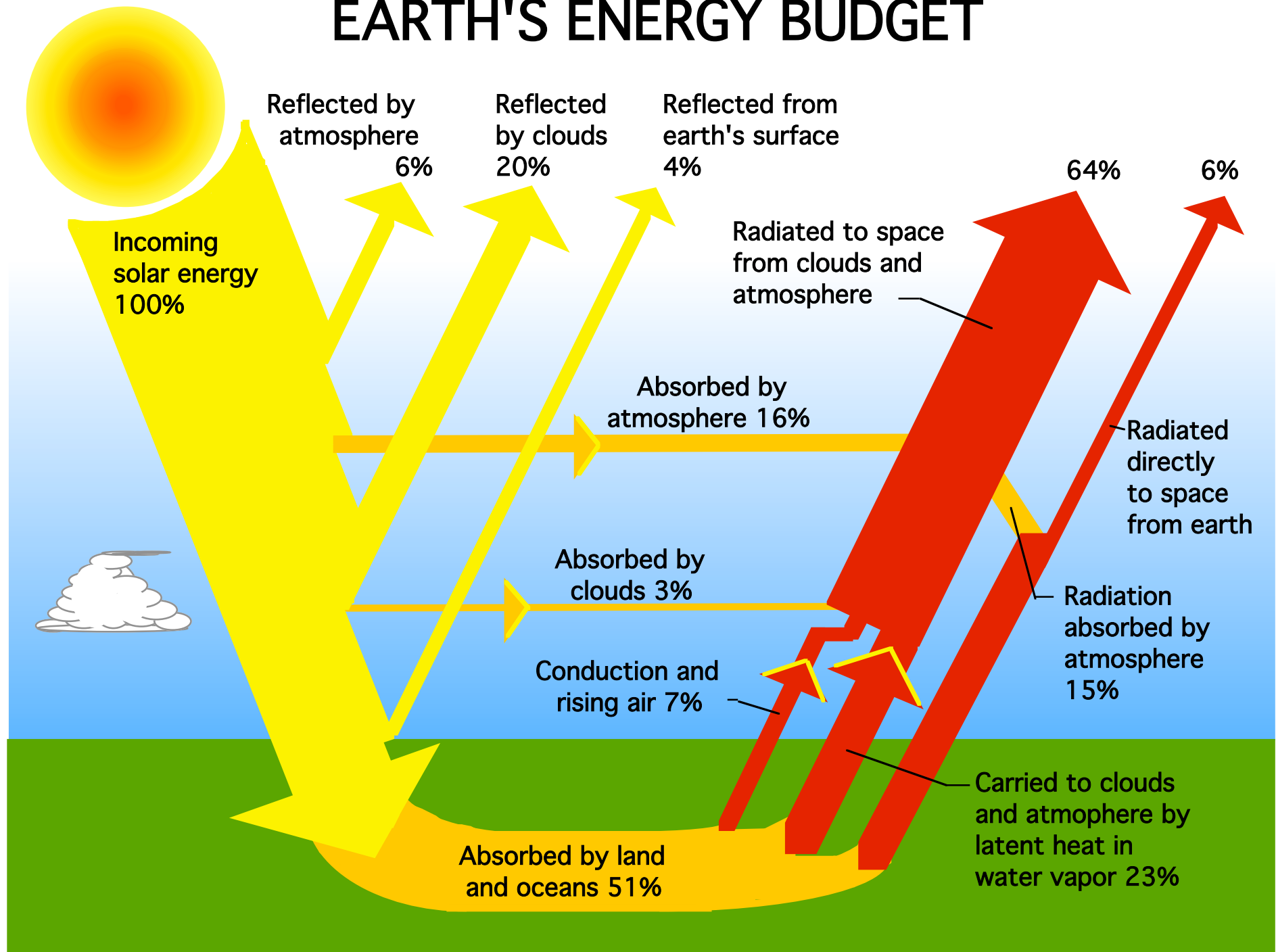
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Global Cloud Cover

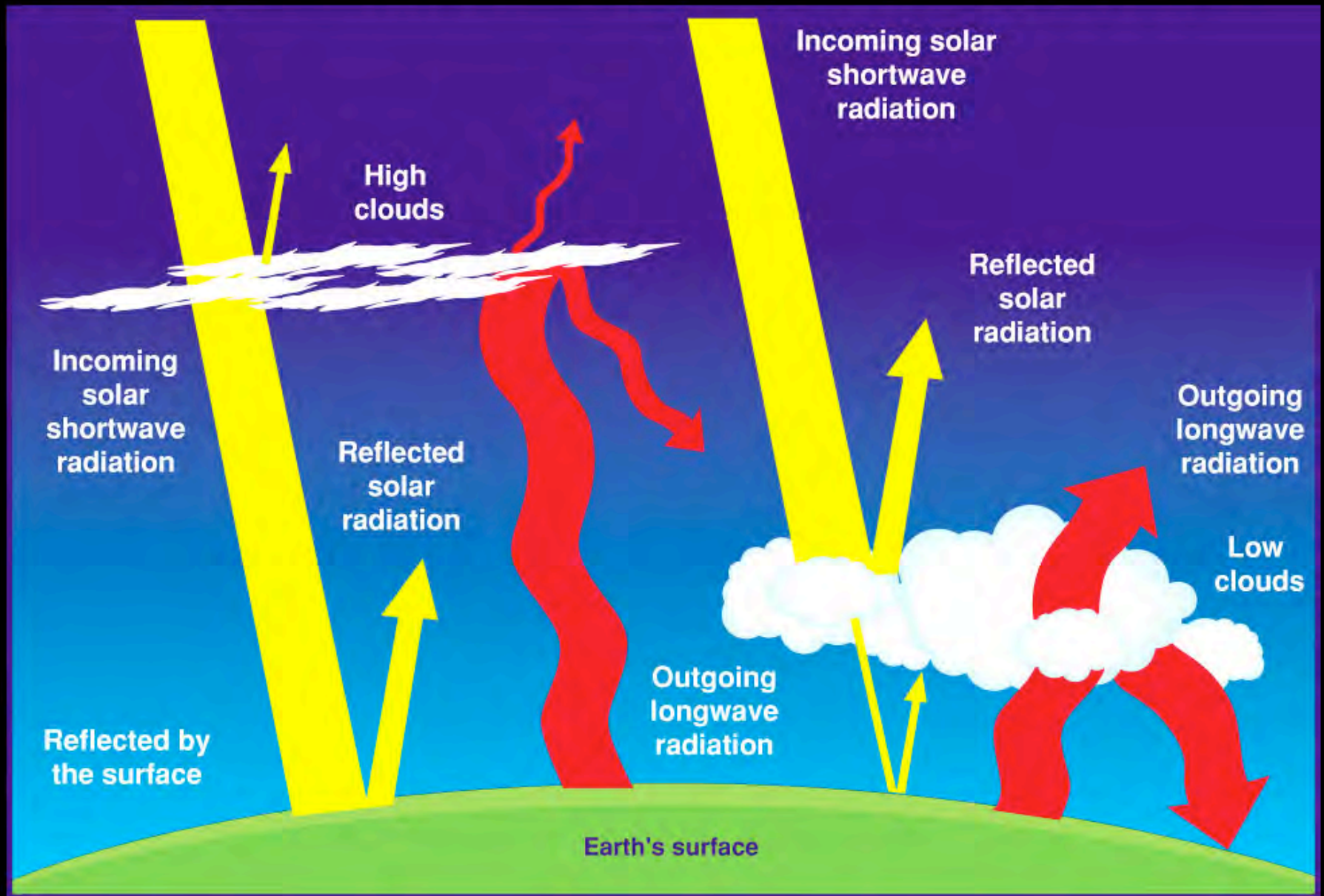
August 26, 1993



EARTH'S ENERGY BUDGET



Cloud Effects On Earth's Radiation

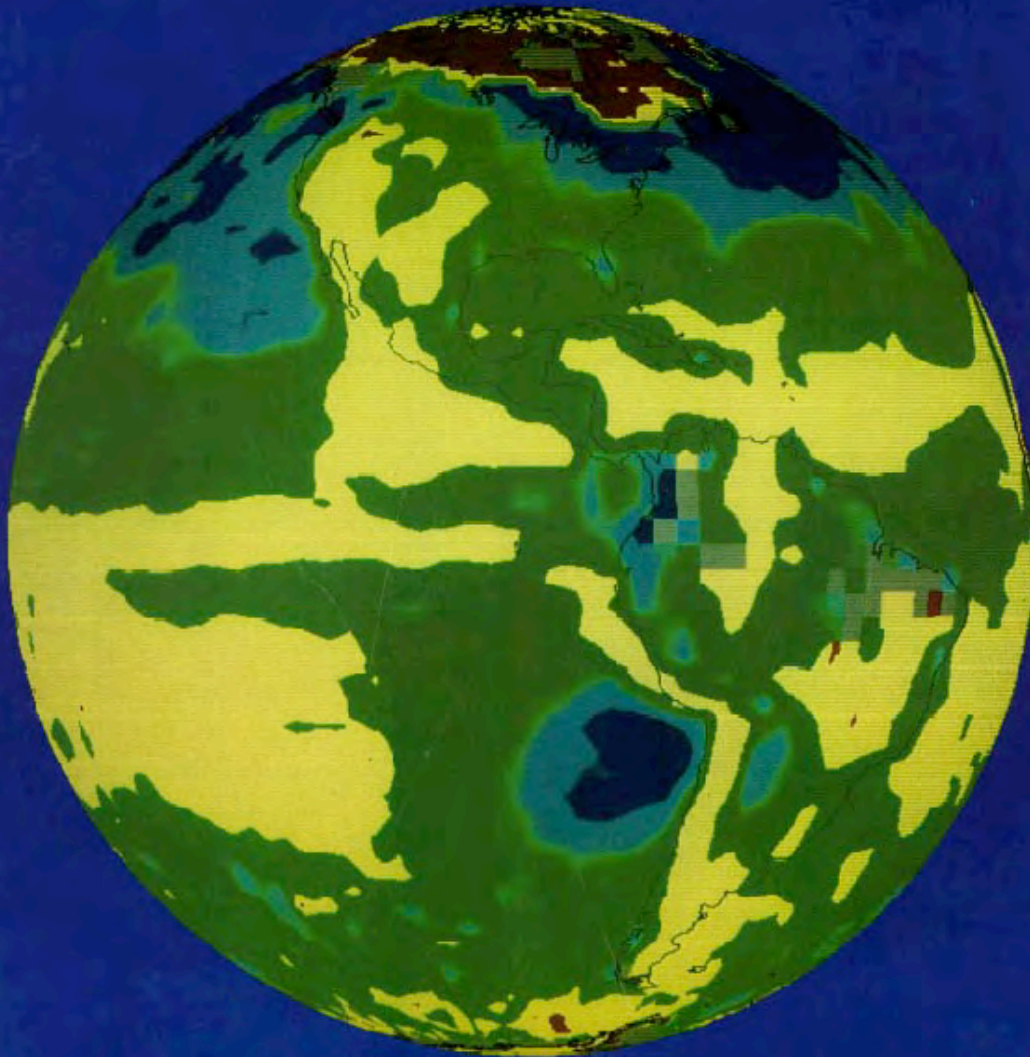


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Derived Product

**Requires Cloud
Detection and
Cloud Property
Retrieval**

Why Do We Study Contrails?



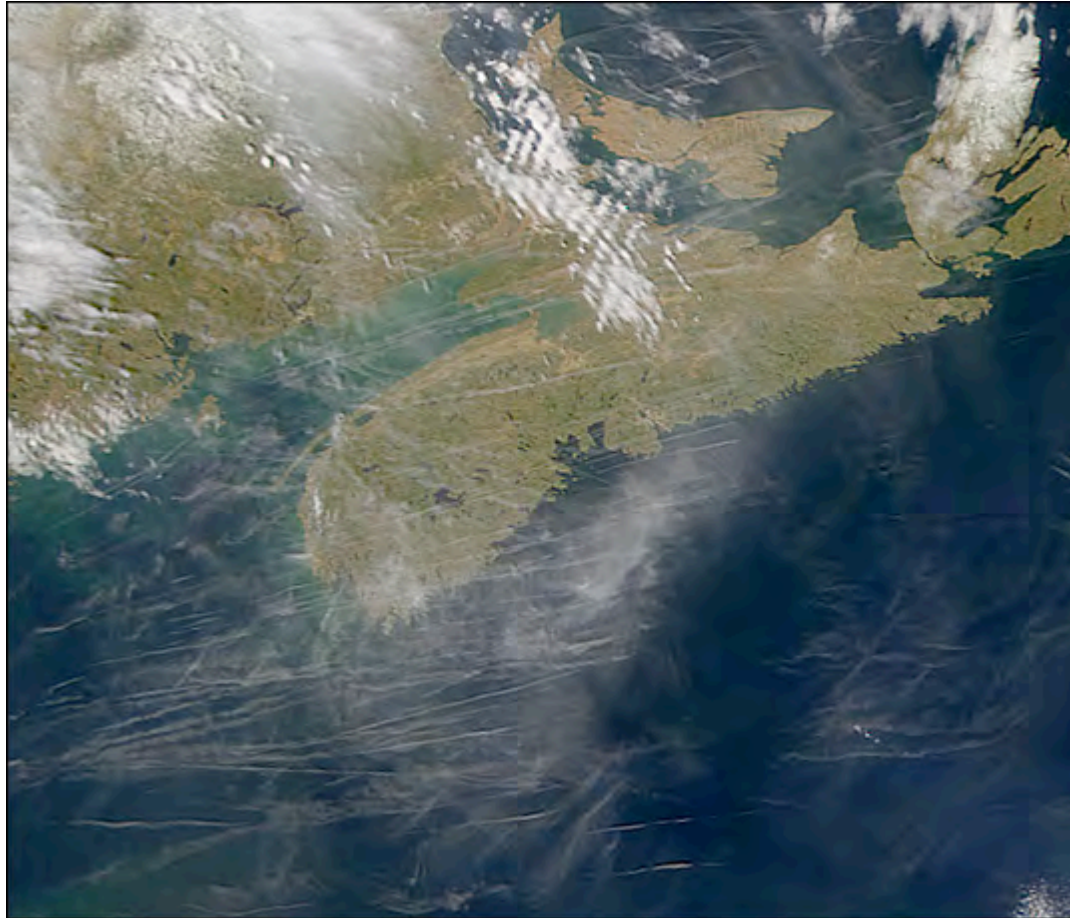
When the upper atmosphere is moist enough, the contrails continue to grow.



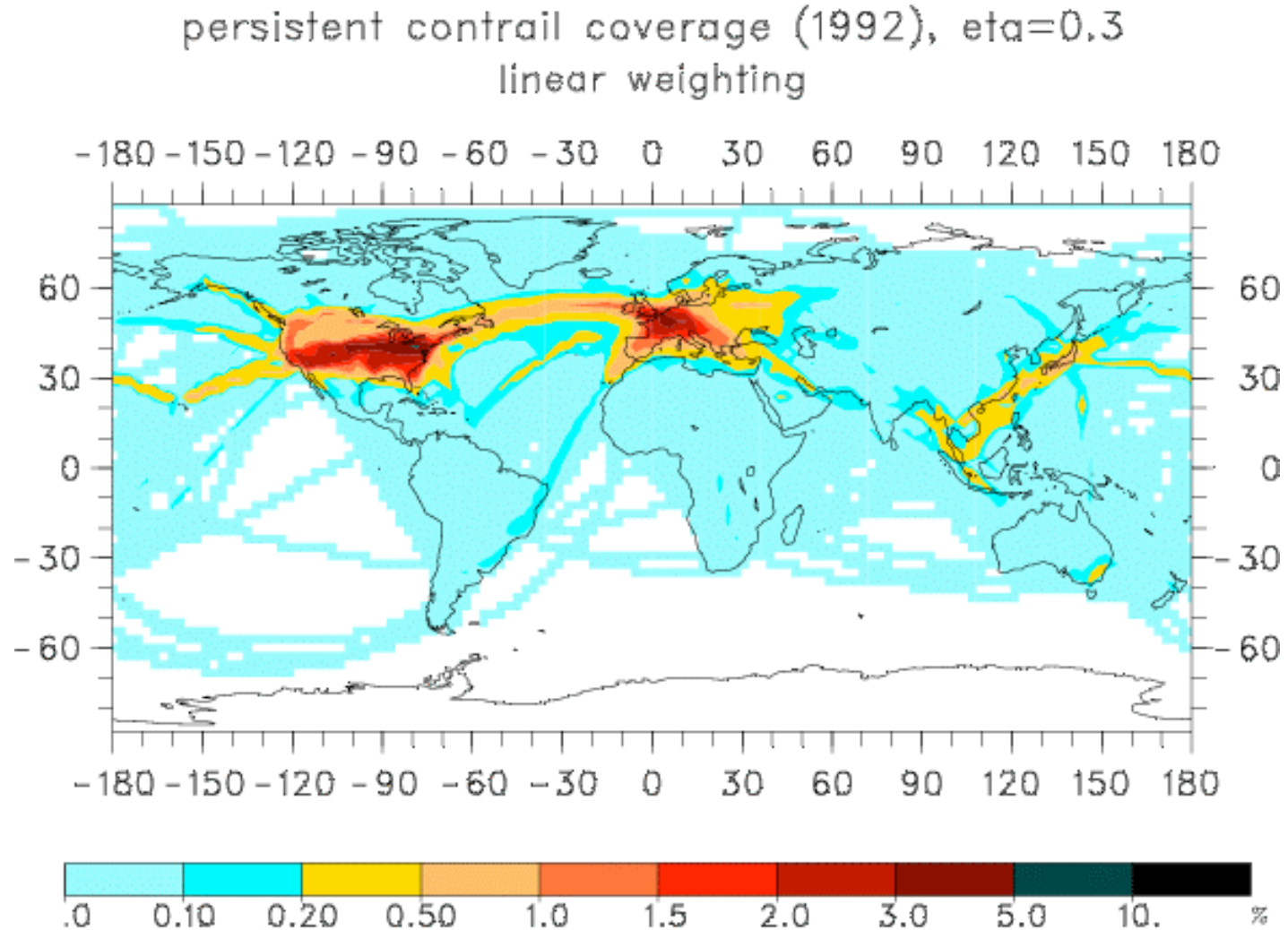
Under these conditions, the contrails become *persistent*.

Persistent
contrails
occasionally
cover large
areas.

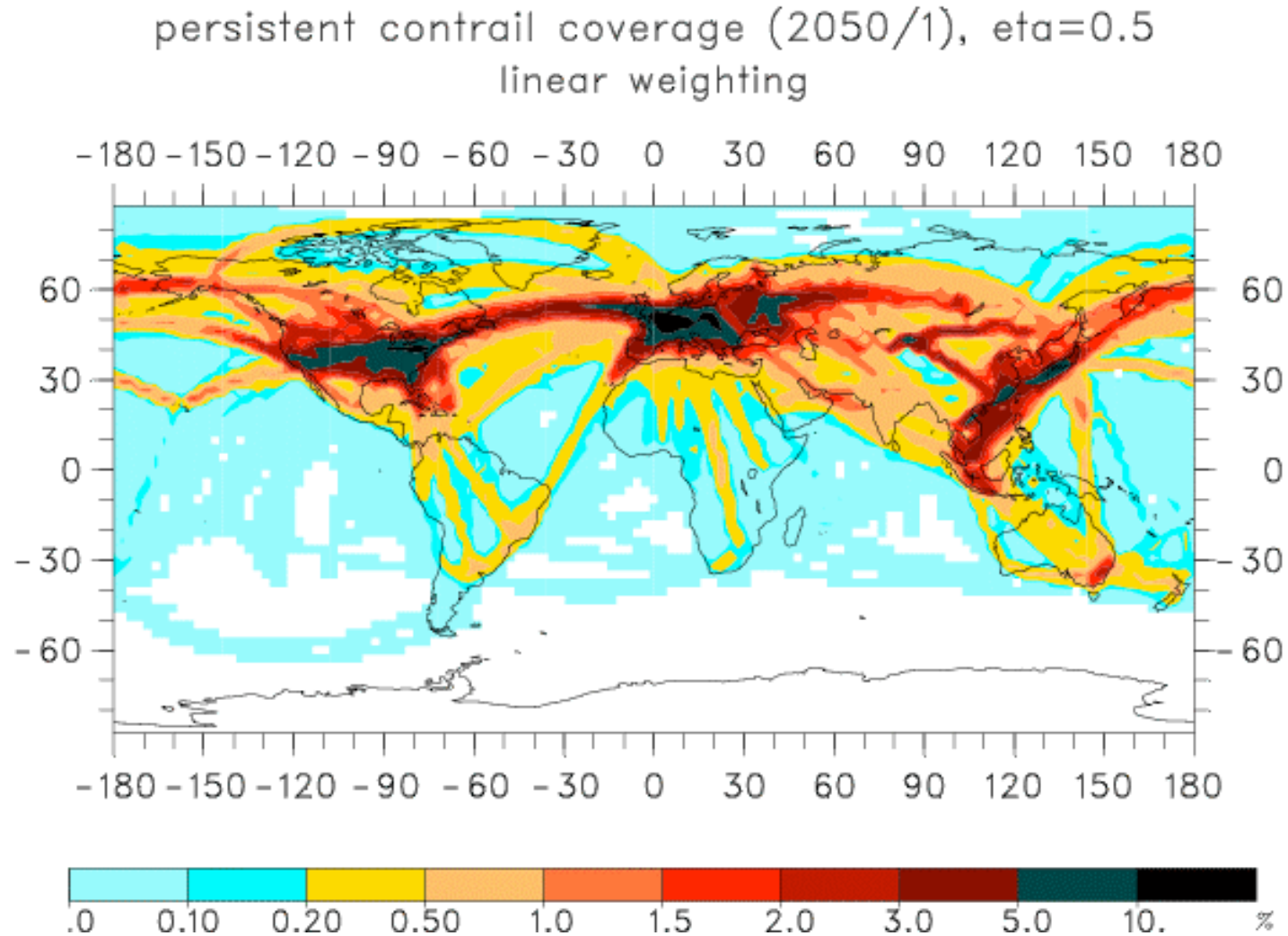
Like cirrus
clouds,
contrails
likely
contribute to
global
warming.



We currently
estimate that
contrails add
an additional
0.5 to 5 %
warming to
the
greenhouse
gas effect.



Air traffic and persistent contrail coverage will continue to increase.



By 2050, warming due to contrails may be 2.5 to 25 % of the current greenhouse gas warming.

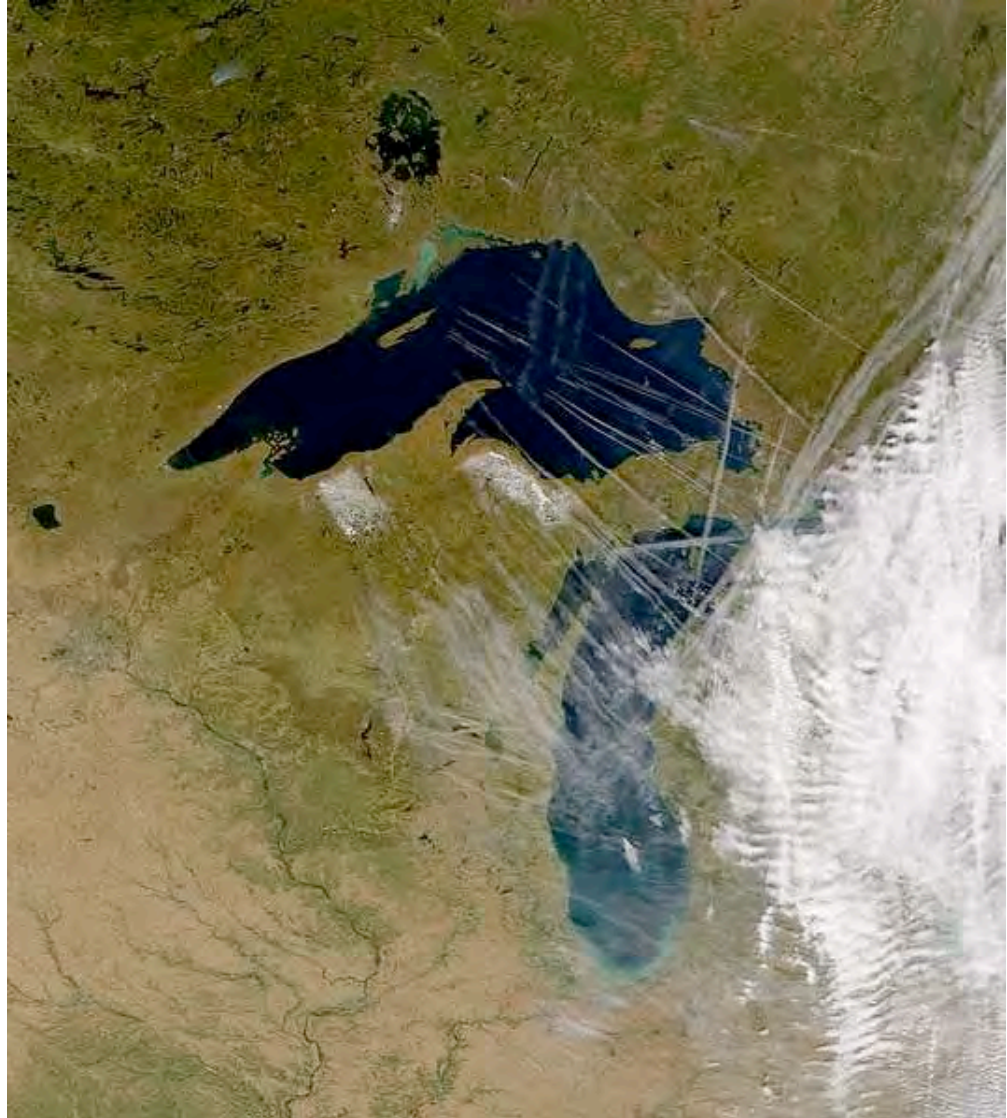
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- ***Why and how are students important to this study?***

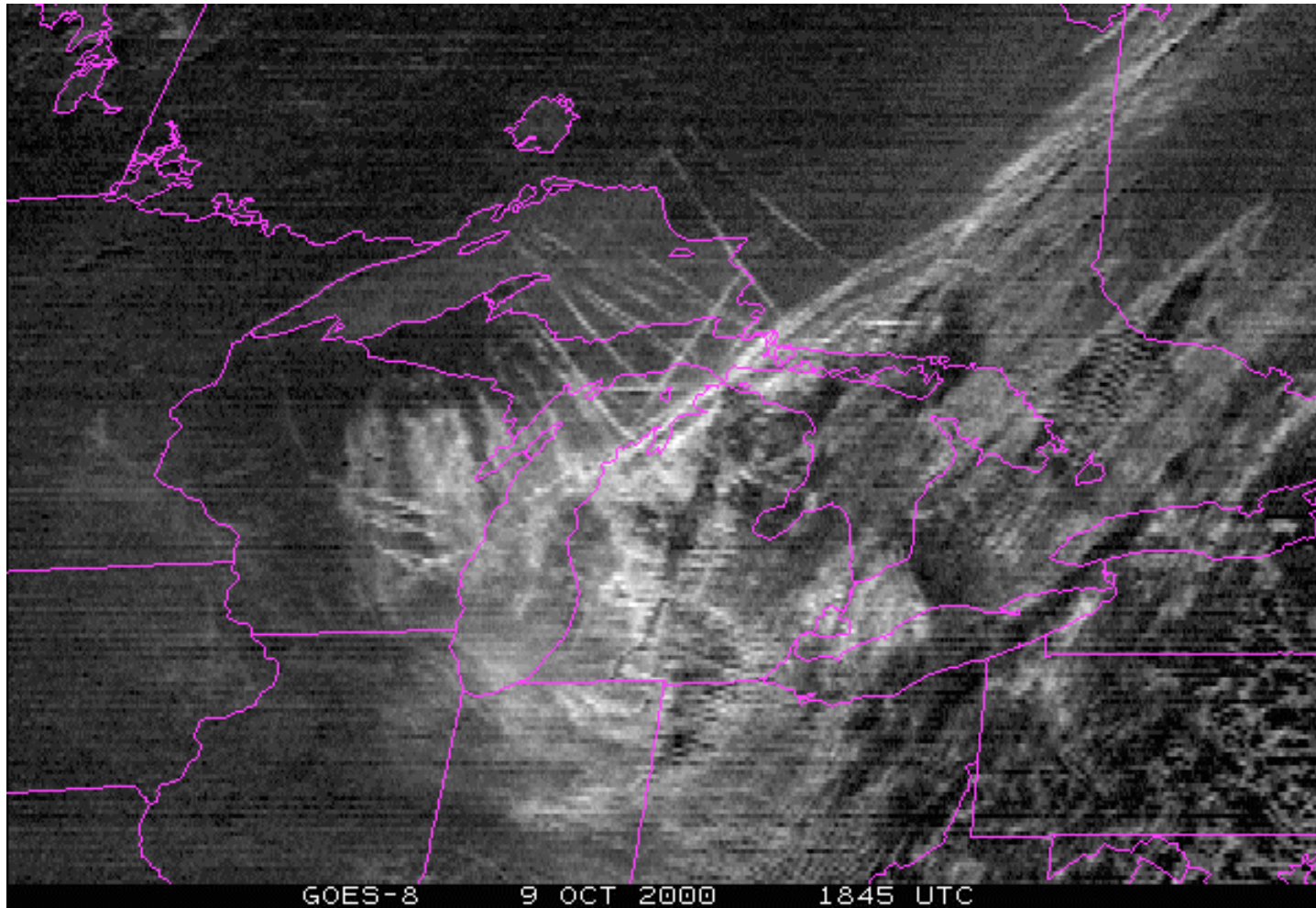
Why can students help?

Our estimates of the climatic effects of persistent contrails are still uncertain.

We still have trouble estimating contrail coverage.



Why can students help?



Most contrails are still smaller than the resolution of most satellites.

Data Sheet

Atmosphere Investigation Clouds 1-Measurement Data Sheet

School Name: _____

Observer names: _____

Date: Year _____ Month _____ Day _____ Study Site: ATM- _____

Local Time (hour:min): _____ Universal Time (hour:min): _____

Cloud Type

High (in the sky):
(Check all types seen)



☐ Cirrus



☐ Cirrocumulus



☐ Cirrostratus

Middle (of the sky):
(Check all types seen)



☐ Altostratus



☐ Altimcumulus

Low (in the sky):
(Check all types seen)



☐ Stratus



☐ Stratocumulus



☐ Cumulus

**Rain or Snow Producing
Clouds:**
(Check all types seen)

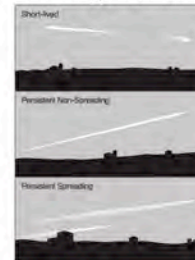


☐ Nimbostratus



☐ Cumulonimbus

Contrail Type (Record the number of each type observed)



Short-lived Contrails

How many do you see? _____

Persistent Non-Spreading Contrails

How many do you see? _____

Persistent Spreading Contrails

How many do you see? _____

Three-quarters or More of the Sky is Visible:

Cloud Cover (Check One)



No Clouds

☐ 0%-No Clouds



Clear

☐ <10% Clouds



Isolated

☐ 10-25% Clouds



Scattered

☐ 25-50% Clouds



Broken

☐ 50-90% Clouds



Overcast

☐ >90%

Contrail Cover (Check one)

☐ No Contrails (0%)

☐ 0-10%

☐ 10-25%

☐ 25-50%

☐ >50%

View of more than one-quarter or more of the sky is blocked: **Obscured** ☐ Check here

Why is the view of the sky blocked? (Check all that apply)



☐ Blowing Snow



☐ Heavy Snow



☐ Heavy Rain



☐ Fog



☐ Spray



☐ Volcanic Ash



☐ Smoke



☐ Dust



☐ Sand

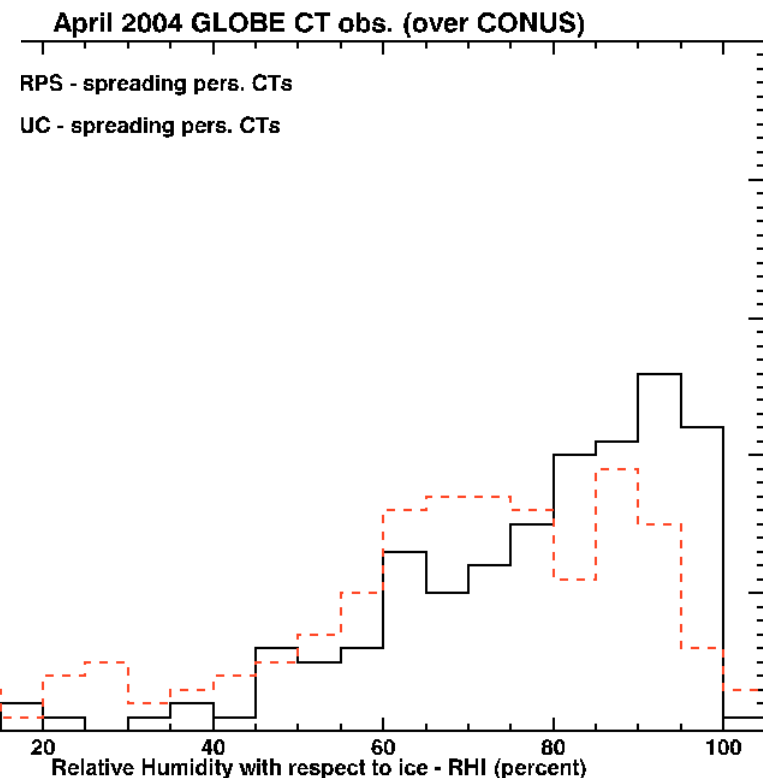
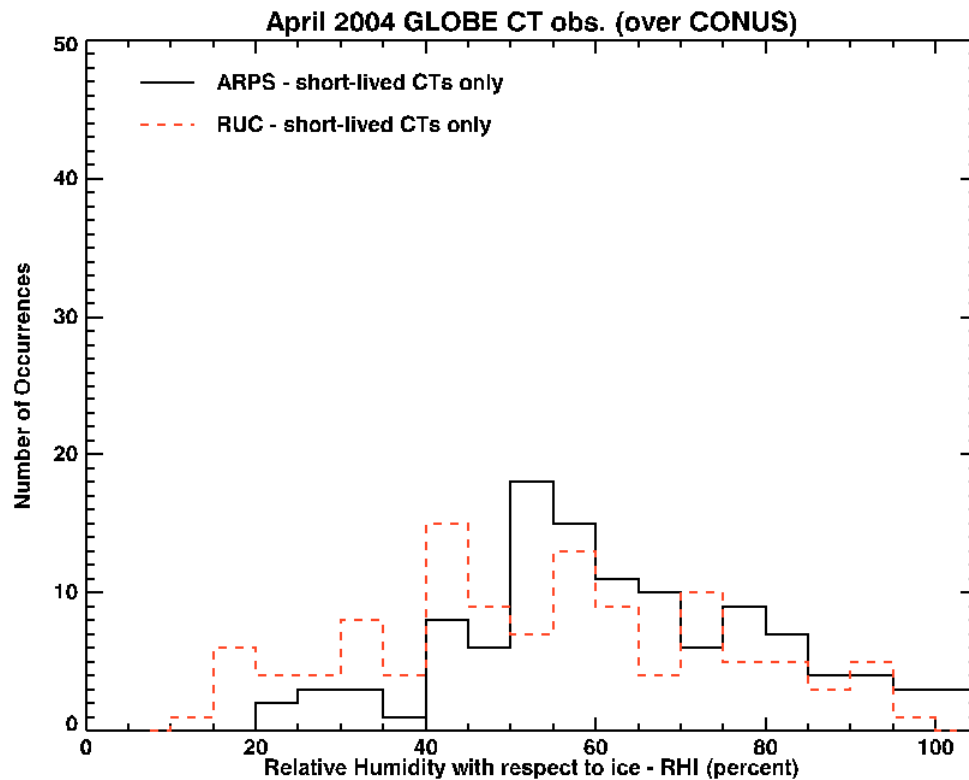


☐ Haze

Comments: _____

Initial GLOBE Contrail Data Analysis

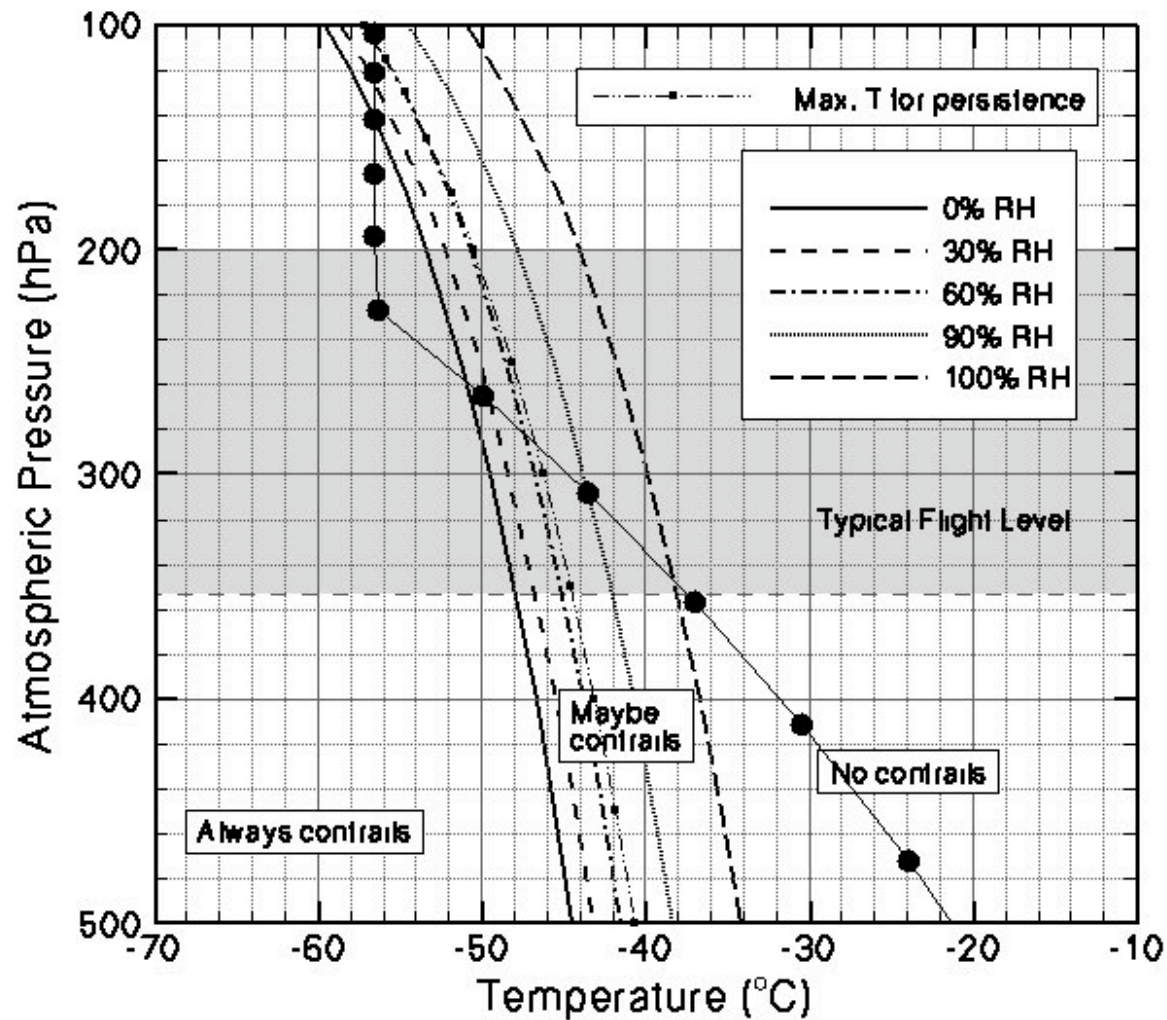
Dr. Dave Duda,
Hampton University




Method

- Compare GLOBE obs to:
 - RUC (Rapid Update Cycle; Benjamin et al.)
 - ARPS (Advanced Regional Prediction System; Xue et al.)
- Initial comparison for April 2004
- 1500 GLOBE observations of contrails

Website & Activities



<http://asd-www.larc.nasa.gov/GLOBE/>

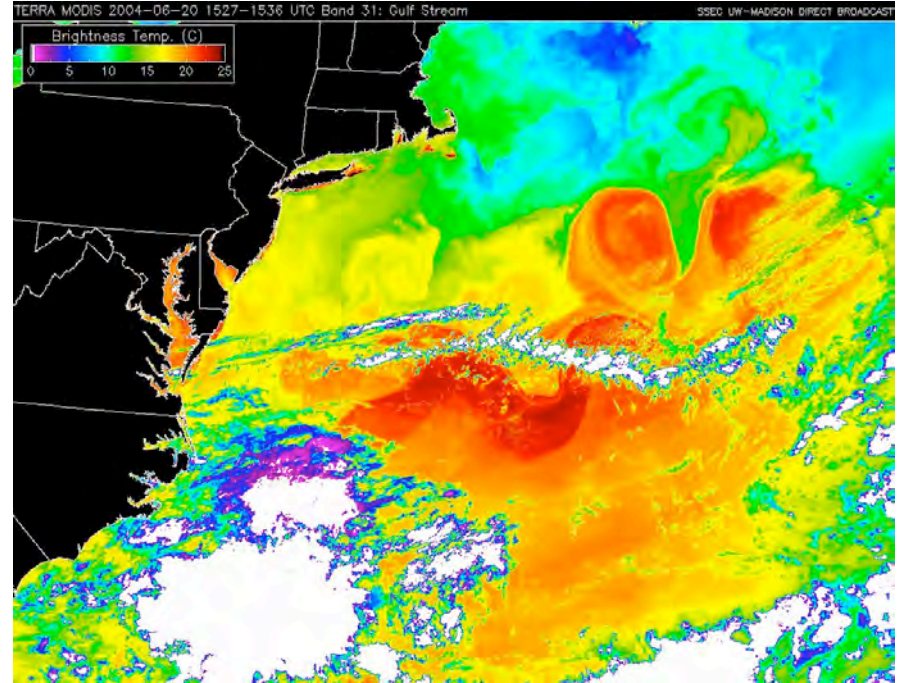
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- Some other things you may see...

Inverse contrails (distrails)



Aircraft sometimes make holes in clouds!

Contrail Cousins



Cloud “zippers” on Father’s Day, 2004

Cloud/Contrail Protocol Summary

- No cost
- No equipment
- Simple
- Website: <http://asd-www.larc.nasa.gov/GLOBE>
- Do any time
- Takes 5–10 minutes
- WE WANT YOUR DATA!!!